



*This document contains the Appendix A and References of the National Coastal Condition Report III.*

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## National Coastal Condition Report III

### Appendix A and References

December 2008

# APPENDIX A

## Quality Assurance



# Quality Assurance

The primary purpose of this appendix is to provide information regarding the sample collection, data quality, and data analysis methods used in this report. This appendix provides additional specific detail and explanation on the analysis of uncertainty (i.e., error estimates) and the assignment of ratings and calculation of scores used in the regional and national assessments. An important programmatic goal is to provide researchers with a large, robust database of coastal environmental information of known data quality. The National Coastal Assessment (NCA) partners have already written many peer-reviewed journal articles using these data. It is our hope that other researchers will recognize the utility of this large database and add to the body of knowledge on coastal monitoring and assessment.

## Analysis of Uncertainty

### Background

As one of the largest and most comprehensive state partnership programs, the NCA allows assessment of ecological condition at state, regional, and national scales. The program partners use the NCA Quality Assurance (QA) Program to monitor and assess the quality of the data collected through NCA activities. The NCA QA Program is conducted under the guidance of the National Health and Environmental Effects Research Laboratory (NHEERL) Director of Quality Assurance. The NCA QA team consists of the following team members:

- **National QA Coordinator**—Assures that a QA program is in place and being followed and that the known quality of the data sets developed by the national contract laboratories is properly documented.
- **Four regional QA coordinators**—Assure that the QA program is being followed and develop the documentation supporting the known quality of the data collected in the NCA.
- **Twenty-four state QA coordinators**—Responsible for reviewing and qualifying all data sets sent to the program from their respective states.

A detailed Quality Assurance Project Plan (QAPP) was developed by the NCA (U.S. EPA, 2001b) and provided to all participants in the program. Compliance with the QAPP is assessed through extensive field training exercises, site visits, reviews, and audits. The QAPP addresses multiple levels of the program, ranging from the collection and laboratory processing of field samples to the review of data sets compiled from the field and laboratory activities. The NCA QA team is responsible for performing assessments of the adequacy of these activities.

### Sample Collection

Approximately 2,200 water quality sites were sampled in both the 1999–2000 and 2001–2002 time frames. This count includes Chesapeake Bay water quality sites, Puerto Rico 2000 sites, and sites in Southcentral Alaska and Hawaii. The number of sites varied slightly among the media sampled based on the acceptance/rejection criteria detailed in the field sampling manual and the QAPP; however, more than 2,000 sites were sampled for each media (except fish tissue, see below) in each of the *National Coastal Condition Report* (NCCR) time periods. To ensure the comparability of data between states, NCA conducted a 4- to 5-day training workshop for all state partners participating in the program. The workshop included training on the application of the probability-based design to state monitoring activities and implementation of the standardized methods required for sample collection. Each state field crew was evaluated on their ability to apply the protocols and received certification after the training based on a field trial. As outlined in the *National Coastal Assessment Field Operations Manual* (U.S. EPA, 2001a), field crews were audited throughout the duration of the program to ensure comparable sampling methods were used. Each field crew is visited once at the beginning of each sampling season and reviewed for adherence to the protocols in the QAPP.



## Data Quality

Before the sampling event began in 2000, NCA convened a diverse panel of environmental scientists to help formulate a list of core indicators to ensure that the NCA collected the appropriate types of data to support its mission. These indicators and the application of these indicators are reviewed prior to NCA data analysis and the publication of each NCCR. In order to ensure that the data collected were of appropriate quality to generate sound estimates on environmental condition, the NCA utilized the U.S. Environmental Protection Agency's (EPA's) concept of data quality objectives (DQOs) to set the overall level of data quality required by management to make informed decisions. In other words, how much error can be tolerated within the measurement process before the data are deemed unacceptable?

NCA developed an a priori, program-level DQO for estimates of condition: "For the cumulative distribution function (CDF) of each index and component indicator of condition, estimate the portion of the resource in degraded condition within  $\pm 10\%$  for the overall system and  $\pm 10\%$  for subregions, with 90% confidence based on a completed sampling regime." Table A-1 shows

that this requirement was met by the estimates of condition in this report for the indices and component indicators in all regions, with the exception of Puerto Rico and the Great Lakes. It should be noted that the uncertainty associated with areal estimates of ecological condition in the Great Lakes cannot be determined because areal estimates of condition were not available for the Great Lakes. Also, the fish tissue contaminants index is expressed as a percentage of fish samples analyzed (Northeast Coast region) or stations where fish were caught (all other regions); therefore, the uncertainty associated with areal estimates of ecological condition cannot be determined.

## Data Assessment Methods

In general, all data assessments for this report followed the methods outlined in the *National Coastal Condition Report II* (NCCR II) (U.S. EPA, 2004a). For most of the regions, the data used in the assessments of condition were collected in 2001 and 2002 (some exceptions exist; see Table A-2). In the Gulf Coast, Southeast Coast, and Northeast Coast regions, these data were compared to similar survey data collected in the 1990s and 2000 to conduct an initial estimate of trends in estuarine condition.

Table A-1. Levels of Uncertainty Associated with the Estimate of Proportion of Area in Poor Condition (2001–2002, except West Coast 1999–2000, and Puerto Rico 2000)

Index/Indicator	Northeast Coast	Southeast Coast	Gulf Coast	West Coast	Great Lakes	Puerto Rico	United States (without AK & HI)	South-central Alaska	Hawaii
Water Quality Index	4%	6%	4%	4%	NA	15%	4%	12%	6%
Nitrogen	5%	2%	2%	3%	NA	14%	3%	14%	11%
Phosphorus	4%	6%	4%	3%	NA	8%	4%	11%	8%
Chlorophyll <i>a</i>	4%	6%	3%	4%	NA	14%	3%	12%	8%
Water Clarity	3%	9%	5%	3%	NA	15%	5%	12%	19%
Dissolved Oxygen	3%	3%	3%	4%	NA	8%	3%	12%	11%
Sediment Quality Index	3%	7%	4%	4%	NA	15%	2%	2%	2%
Sediment Toxicity	3%	3%	3%	4%	NA	10%	1%	11%	11%
Sediment Contaminants	3%	2%	2%	5%	NA	10%	2%	2%	6%
Sediment TOC*	6%	5%	3%	4%	NA	16%	2%	11%	10%
Coastal Habitat Index	<.1%	<.1%	<.1%	<.1%	NA	NA	<.1%	NA	NA
Benthic Index	4%	7%	4%	4%	NA	15%	3%	NA	NA
Fish Tissue Contaminants Index	NA	NA	NA	NA	NA	NA	NA	NA	NA

\* total organic carbon (TOC)

**Table A-2. Years Assessed for NCCR III Condition Estimates and for Trends in Condition**

Region	Years Assessed for NCCR III	Years Assessed for Trends
Northeast Coast	2000–2002	1990–1993, 2000–2001
Southeast Coast	2001–2002	1994–1997, 2000–2002
Gulf Coast	2001–2002	1991–1994, 2000–2002
West Coast	1999–2000	NA
Great Lakes	2001–2002	NA
Southcentral Alaska and Hawaii	2002	NA
Puerto Rico	2000	NA

## Assignment of Ratings and Calculation of Scores

### Determining Rating Scores for Indices

The data analysis methods that were used to determine rating scores for the regional and national condition indices and component indicators were similar to those used in the NCCR II. These

methods are outlined below and summarized in a series of tables showing the ranges of values used for the indices, component indicators, and rating scores.

The data analysis process includes several steps, which are outlined in Chapter 1. Briefly, each site receives a rating of “good,” “fair,” or “poor” for each index and component indicator (see Tables 1-23, 1-24, and 1-25 in Chapter 1), depending on the value of that index or component indicator. The range of values for these indicators was determined from literature, best professional judgment, or expert opinion (Table A-3). In some cases, different value ranges were determined for different regions based on comments from peer reviewers and consultations with state water quality managers. These ranges are reevaluated for each NCCR by groups of experts including academic scientists, government scientists, and others. For the component indicators and the benthic and fish tissue contaminants indices, the rating at each station (or fish samples analyzed for the fish tissue contaminants index in the Northeast Coast region) is then translated to scores (good = 5, fair = 3, poor = 1). The water quality and sediment quality index, which are the two indices with component indicators, ratings for each station are calculated based on how many component indicators received a poor rating.

**Table A-3. Sources of Information to Establish Ranges of Indicator Values for Good, Fair, or Poor Ratings**

Index or Component Indicator	Source
Water Quality Index	Best professional judgment; consultations with experts and selected state water quality managers
Dissolved Inorganic Nitrogen (DIN) Dissolved Inorganic Phosphorus (DIP) Chlorophyll <i>a</i>	Bricker et al., 1999; selected state criteria for chlorophyll <i>a</i> in coastal waters
Water Clarity	Smith et al., 2006; best professional judgment; consultations with selected state water quality managers
Dissolved Oxygen	Diaz and Rosenberg, 1995; U.S. EPA, 2000a; selected state criteria for dissolved oxygen in coastal waters
Sediment Quality Index	Best professional judgment; consultations with experts and selected state water quality managers
Sediment Toxicity	U.S. EPA, 1994
Sediment Contaminants	Long et al., 1995; consultations with experts
Sediment TOC	Best professional judgment; consultations with experts and selected state water quality managers
Benthic Index	Engle et al., 1994; Weisberg et al., 1997; Engle and Summers, 1999; Van Dolah et al., 1999; Hale and Heltsche, 2008
Benthic Diversity (in lieu of benthic index)	Best professional judgment; consultations with experts
Fish Tissue Contaminants Index	U.S. EPA, 2000c; consultations with experts

To determine the regional ratings, an areally weighted CDF is then calculated for each index and component indicator (except for the fish tissue contaminants index) for the distribution of sites in each region to show what percentage of the area in each region has scores of 1 (poor), 3 (fair), and 5 (good). The CDF also calculates error estimates and 95% confidence intervals. The region is then rated overall as good, fair, or poor for each index or component indicator based on the percent area that is rated poor and fair for each index or indicator. The regional rating for the fish tissue contaminants index is based on the percentage of fish samples analyzed (Northeast Coast region) or monitoring stations where fish were caught (all other regions) in poor or fair condition. For the all of the indices of condition, the “fair” rating can have a score of 2, 3, or 4. This distinction was based on best professional judgment and was used to determine when final scores were “fair to poor” or “good to fair” rather than just fair. The specific ranges in percent area with poor ratings that result in scores of 2, 3, or 4 are shown in Table A-4. If a region has < 50% of its coastal area (or for the fish

tissue contaminants index, fish samples analyzed [Northeast Coast region] or stations where fish were caught [all other regions]) rated good, then the score is 3 and the region is rated fair. The regional rating for the coastal habitat index is determined based on the average rate of wetland loss as indicated by data from the NWI (Dahl, 2002).

Additional steps are required to calculate the “overall condition” score for each region. The overall condition score for a region is an average of the final scores for each index. In this calculation, the “fair” rating can also have a score of 2, 3, or 4.

To create the national index scores, an areally weighted average was calculated from the regional index scores. Each regional index score was areally weighted by the percentage of total area of U.S. estuaries and coastal embayments in each region. For example, the weighted average for the national water quality index was calculated by summing the products of the regional water quality index scores and the coastal area contributed by each region (Table A-5). The national overall condition score was then calculated by summing each national index score and dividing by five.

**Table A-4. Ranges of Percent Area Rated Poor that Result in Scores of 1 – 5**

Index	Poor (1)	Fair to Poor (2)	Fair (3)	Good to Fair (4)	Good (5)
Water Quality Index	> 20%	18–20%	13–17%	10–12%	< 10%
Sediment Quality Index	> 15%	13–15%	8–12%	5–7%	< 5%
Benthic Index	> 20%	18–20%	13–17%	10–12%	< 10%
Fish Tissue Contaminants Index (% of sites)	> 20%	18–20%	13–17%	10–12%	< 10%

**Table A-5. Calculation of the National Water Quality Index Score**

Region	Water Quality Index Score (A)	Proportion of U.S. Estuarine Area (B)	Product (A × B)	National Water Quality Index Score
Northeast Coast	3	0.167	0.501	Sum (A × B) = 3.701
Southeast Coast	3	0.075	0.225	
Gulf Coast	3	0.171	0.513	
West Coast	3	0.063	0.189	
Southcentral Alaska	5	0.347	1.735	
Hawaii	5	0.002	0.010	
Great Lakes	3	0.175	0.525	
Puerto Rico	3	0.001	0.003	

## Fish Tissue Contaminant Assessments in NCCR III

There is currently no EPA guidance available for evaluating the ecological risk of whole-body contaminant burdens in fish. EPA's *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories: Volume 2: Risk Assessment and Fish Consumption Limits* (U.S. EPA, 2000c) provides guidance for estimating the contaminant risk that non-commercial fish and shellfish pose to consumers. This guidance is intended to be used by the local, state, regional, and tribal environmental health officials responsible for issuing fish consumption advisories. To that end, the assessments of fish tissue contaminants in the NCCR II and the *National Coastal Condition Report III* (i.e., NCCR III) relied on the suggested human health “benchmarks” provided in this guidance document. In essence, if concentrations of contaminants found in the fish tissue met or exceeded a human health consumption endpoint, then best professional judgment determined that the fish were likely exposed to an environmentally available contaminant.

The methodology recommended in the EPA fish advisory guidance document (U.S. EPA, 2000c) and cited in the two previous NCCR documents was used as a surrogate method for establishing an “ecological threshold value” for fish and shellfish. The EPA guidance document was designed to provide a method for assessing the health risks to consumers of eating chemical-contaminated fish and shellfish that are harvested from local waterbodies by recreational or subsistence fishers (those who rely on fish as a primary source of protein). The guidance provides a methodology for developing fish consumption limits for 25 high-priority chemical contaminants (i.e., target analytes). These target analytes were selected by EPA's Office of Water as

significant contaminants based on their documented occurrence in fish and shellfish, persistence in the environment, potential for bioaccumulation in aquatic food webs, and oral toxicity to humans. The fish advisory threshold values used in the NCCR reports (see Table 1-20) are based on values for adults in the general population who fish recreationally and consume their catch. The EPA guidance also provides information on input values for use in calculating fish advisory threshold values so that they are applicable to more vulnerable populations (e.g., pregnant and nursing women, or young children) as well as to subsistence fishers who typically consume larger quantities of fish from local waterbodies than the general population. The NCA analyzed fish tissues for 81 chemical analytes, 16 of which matched the target analyte list provided in the fish advisory guidance document (U.S. EPA, 2000c). These 16 analytes were the only chemical contaminants monitored by the NCA for which quantifiable surrogate “ecological threshold values” could be calculated to evaluate fish tissue contaminant concentrations. For each analyte, a concentration range was calculated that provided for safe consumption of four 8-oz fish meals per month by a 154-pound adult. For example, the risk-based EPA Advisory Guidance values for mercury ranged from 0.12 to 0.23 ppm of mercury in fish tissue. If the NCA measured a concentration in fish that was less than 0.12 ppm of mercury, then the fish sample analyzed (in the Northeast Coast region) or the monitoring station where fish were caught (in all other regions) was rated good. If the contaminant concentration measured in fish tissue was within the EPA Advisory guidance value range, then the fish sample analyzed or monitoring station where fish were caught was rated fair; and if the mercury concentration exceeded 0.23 ppm, then the fish sample analyzed or monitoring station where fish were caught was rated poor.



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A photograph of a sailboat with a yellow and red sail sailing on a choppy blue sea under a clear sky. The sailboat is positioned in the lower right quadrant of the image, with its sail fully deployed. The water is dark blue with white foam from the waves. The sky is a pale blue. The overall image has a wavy, layered appearance with semi-transparent white and light blue bands.



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# National Coastal Condition Report III



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